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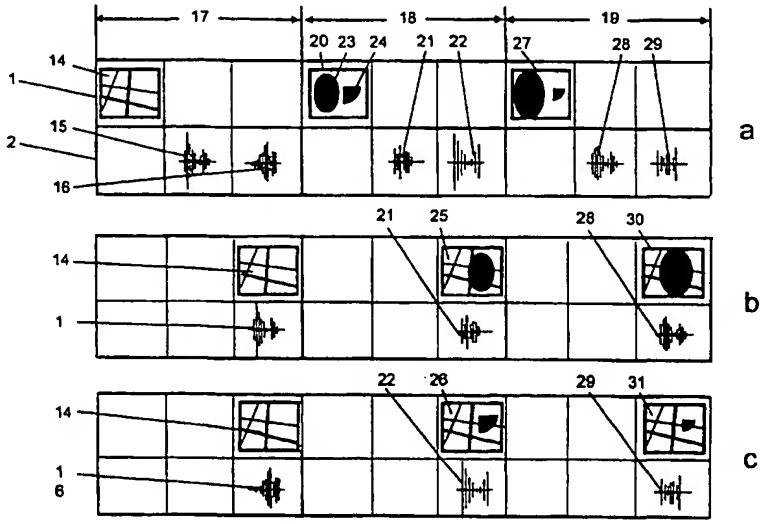

(57) Abstract

A system for the development and reception of locally interactive television and radio programmes. The system involves the creation of multiple programme sub–steams which can be selectively presented to the viewer in response to choices previously made by the viewer and logged by the viewers' receiving equipment. The interactivity is completely local so the data downloaded during the broadcast is all that is required to provide the viewer with all the alternative programme sub–streams. This system is suitable for all digital broadcasting systems. Background images (14) are distributed together with image groups (20, 27) which may be combined selectively with the background images to form separate programme sub–streams. The image groups may be distributed in the video stream or in the accompanying user/private data stream. The image groups may be selected for inclusion in one or more programme sub–streams.

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INTERACTIVE TELEVISION AND RADIO SYSTEM

FIELD OF THE INVENTION

This invention relates to the creation and display of interactive television and radio programmes which enable viewers and listeners to interact with the system to vary programme content. The invention is particularly suited to digital television and/or radio systems.

BACKGROUND TO THE INVENTION

There are several types of interactive television system already available which allow the viewer to interact with the programme usually by means of a hand-held device. In one type of system which is used for on-line shopping, banking etc. the viewer is presented with a list of goods or services displayed on the television screen and the viewer can make a selection from this list by means of the hand-held device. This selection is logged by the viewer premises equipment and distributed to a central control unit usually by means of a telephone landline. In the case of games of skill the viewer is provided with a range of possible answers to a question and these answers are compared, by control and processing logic in the viewer premises equipment, with a table of correct answers previously downloaded by the system. Points are then awarded to the viewer, by the system, on the basis of the answers selected by the viewer.

In both these systems the way in which the programme progresses is unaffected by the viewer or listener.

There are other systems where the manner in which the programme continues is to some extent is affected by the viewer or listener, for example, in the case of a

televised football match the viewer may be allowed to select from a range of alternative camera angles. In this system several video sub-channels are simultaneously broadcast and the viewer can switch between them. In this example considerable additional bandwidth is required since this option is virtually equivalent to switching between two separate programme broadcasts. Such systems are not truly interactive as the system does not influence the manner in which the programme progresses.

SUMMARY OF THE INVENTION

The aim of the present invention is to provide an interactive programme distribution method which can allow the user to influence the manner in which the programme progresses.

The invention is defined by the independent claims to which reference should be made.

Embodiments of the invention have a number of advantages over prior art systems. In particular they enable programme makers to create sophisticated interactive television and radio programmes suitable for broadcasting i.e. a programme development environment PDE).

Such interactive programmes may be presented allowing the viewer or listener to engage in, by way of example, some form of examination, quiz, test, selection process etc.

Viewers' or listeners' choices may be logged and the choices compared with a table of previously downloaded correct or appropriate choices.

Furthermore, a selection may be made from several alternative paths of the path along which the programme can continue on the basis of the results of the comparison of the viewers' or listeners' choices with pre-stored content at the receiver. This has particular advantage in educational systems where the response of a user to questions asked in the main programme content will determine which programme sub-stream is present to that user. This enables an educational programme to be tailored precisely to each viewer or user's development with each user being presented with their personal combination of extracts from the available programme sub-streams.

Embodiments of the invention may enable users to engage in educational programmes where instruction is presented on a particular discipline and the viewer or listener is then presented with test material to which they are expected to respond and their response determines which of several programme options are selected, by the system, for the viewer to see or the listener to listen to.

DESCRIPTION OF DRAWINGS

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows the flow of data blocks in a section of a programme stream in accordance with a first embodiment of the invention;

Figure 2 shows how a number of potential programme sub-streams may be created with a common background from a single broadcast video stream;

Figure 3 shows the flow of data blocks in the example of figure 2;

Figure 4 shows how two programme sub-streams may be created each with different backgrounds from a single broadcast programme stream;

Figure 5 shows how two programme sub-streams may be created using image groups in a user/private data stream;

Figure 6 shows the flow of data blocks in the example of figure 5;

Figure 7 shows how a toolkit of images may be downloaded in the user/private data stream to create two programme sub-streams;

Figure 8 shows how three backgrounds may be created from a single video stream;

Figure 9 shows how the technique illustrated in figure 8 may be combined with the use of programme sub-stream in the user/private data block shown in figures 5 and 6;

Figure 10 shows how background panning may be provided for general programme sub-stream with a single video stream;

Figure 11 shows how displacement vectors may be calculated;

Figure 12a, b and c show, respectively, three receiving and presenting television broadcasts;

Figure 13a, b, and c show a further three possible equipment configuration; and

Figure 14 shows a control unit for linking to an IRD or digital television for reception and presentation of programmes.

DESCRIPTION OF BEST MODE

The embodiments of the invention to be described generate several alternative programme paths and make these available separately for presentation to the viewer or listener. These programme paths, or sub-streams, may be created in one of several ways.

Type I

The broadcast is actually made up of several discrete and complete programme sub-streams. The system will then be switching between simultaneously broadcast programme sub-streams in response to the viewers' responses and under the overall control of software previously loaded into the viewer premises equipment and/or supplemented with software downloaded during the broadcast. This system can be applied to both radio or television broadcasts. The term broadcast used herein refers to the distribution of a programme and includes all conventional methods of distribution such a terrestrial broadcast, satellite broadcast, cable and on-line distribution.

Data compression systems are used throughout digital television broadcasting to reduce the broadcast data levels to manageable sizes. The current standard system which has been adopted by a large numbers of countries for satellite, cable and terrestrial domestic television broadcasts is MPEG-2. Currently the bit-rate of a typical domestic television broadcast will be in the range 1.5 to 7.5 Mbits/sec. Within this range the bit-rates around 3 Mbits/sec will probably be reserved for programmes such as talk shows where little movement takes place and the higher rates used for high motion programme material such as sports. Good quality video will be obtained at these bit-rates while the lower bit-rates of around 1.5 Mbits/sec will be used for non-critical film material. So using the higher bit-rate levels of around 7.5 Mbits/sec and above will allow several discrete alternative programme paths with reasonable picture quality to be generated for programmes where little or slow movement is involved, although from the service providers point of view this is an expensive method.

The embodiment of the invention described can operate within the structure defined by MPEG-2 but are not dependant on it. The encoding system used by the broadcasting service, whether MPEG-2 or any other, will be referred to in this document from now on as broadcast encoding.

Figure 1 presents an example of the flow of data blocks in a programme stream in a system where, for the example, two alternative programme sub-streams are available. This figure represents the data blocks which will be downloaded within approximately 1/25th or 1/30th of a second depending on the broadcast standard adopted i.e. during the time interval between consecutively screened pictures - the picture cycle period. In this figure the relative position of the various data blocks within the streams represents only one possible arrangement. Other arrangements of these data blocks are possible according to this invention.

Row 1 in Figure 1 represents the broadcast encoded video stream containing two encoded pictures 10 and 11. These pictures belong to two separate and discrete programme sub-streams. Associated with these pictures are the encoded audio blocks 12 and 13 in the broadcast encoded audio stream 2. These encoded pictures and encoded audio blocks are controlled by data in the user/private data stream 3. MPEG-2 utilises a lossey data compression system and this type of compression system will probably be used for most if not all the broadcast encoding systems that will be employed in the near future. All the information required by the present embodiment to control the data flow will be included in the user/private data stream which is not broadcast encoded. This is represented by the data stream 3 in Figure 1. In this example the user/private data stream 3 contains several types of data and it may be necessary to compress these data to come

within the overall maximum bit-rate allowed. Appropriate lossless compression systems will be used e.g. JPEG, TARGA, the PKZIP file archiving utility, the Portable Network Graphic Format (PNG) or variants, Run-Length Encoding, Graphics Interchange Format (GIF) or variants etc.

Whether the data block is encoded and which encoding system is used will be defined in the header section of the particular encoded block. The user/private data stream 3 includes a frame marker 4 which identifies the start of a frame data block i.e. all the blocks of data necessary (from the video, audio and data streams) to create all the final pictures available for one picture cycle. This frame marker block may also contain, amongst other information, a presentation time stamp i.e. the time when the particular picture plus audio block from this frame data block are presented to the viewer. This block is followed by a code segment block 5 i.e. a block of software. The code segment block contains a header section including, amongst other information, a code identifying this as a software code block. This header section is followed by the software code required to control this section of the transaction block. A software code block may not always be included.

A picture header block 6 follows which starts with a header section identifying this as a picture header block and may also contain, amongst other information a unique identifier for this particular picture header block and a stream identifier to define to which programme sub-stream the associated broadcast encoded picture 10 belongs. An audio header block 7 follows which starts with a header section identifying this as a audio header block and may also contain, amongst other information, a stream identifier to define to which programme sub-stream the associated broadcast encoded audio block 12 belongs. This

sequence of picture and data blocks is repeated (8 and 9) for the broadcast encoded picture 11 and the associated audio block 13. In this way the pictures and audio blocks making up the various programme sub-streams are encoded in the streams 1 and 2 while the necessary associated control data are downlinked in the user/private data stream 3. So two separate pictures 10 and 11 together with two separate audio blocks 12 and 13 are downloaded within one picture frame cycle. In this manner two alternative programme streams are made available for the controlling software to select from for presentation to the viewer. The method described can be supported with MPEG-2 by broadcasting the video stream at one of the higher data rates permitted by MPEG-2, for example 7.5MBits/sec but coding the pictures of each of the separate streams at a lower rate, for example 3MBits/sec or less. Thus, the sub-streams are encoded at a combined data rate less than or equal to the broadcast data rate.

The necessary information obtained in the various data blocks could be included in a smaller number of blocks, possibly a single block and could relate to more than one picture cycle period.

Depending on the bit-rate of each programme stream and the total maximum allowed bit-rate more than two programme streams can be broadcast simultaneously.

Type II

In a second embodiment of the invention, which is applicable to television broadcasts, several discrete audio streams are produced which are broadcast simultaneously but only one video stream is broadcast. From this single video stream, possibly with other images from the user/private data stream, several discrete video

sub-streams are created under the overall control of software previously loaded into the viewer premises equipment and/or supplemented with software downloaded during the broadcast. The television broadcast thus contains several potential programme sub-streams and the sub-stream which any particular viewer will see is created just prior to presentation at the users receiver. This is a far more economical method of creating multiple programme sub-streams.

There are a number of ways in which multiple potential programme sub-streams may be created and these will now be described as examples A to F.

VERSION A

Some of the pictures in the decoded video stream act as a common background for all the potential programme sub-streams while each of the remaining pictures contains several images from which sets of images can be selected to superimpose on the background to form the final programme sub-stream.

Figures 2 and 3 illustrate how this technique may be used to create two potential programme sub-streams. In these figures the relative positions of the various data blocks within the streams represents only one possible arrangement; other arrangements of these data blocks are possible according to this invention. In Figure 2 the combined broadcast video and audio streams are represented by the row **a** and the two potential programme sub-streams which can be formed from **a** are represented by the rows **b** and **c**. The three time intervals indicated by 17, 18 and 19 are each equal to one picture cycle period. The video and audio streams in Figure 2**a** are indicated by 1 and 2 respectively and the first picture 14 in the video stream

1 acts as the background for the two potential programme sub-streams **b** and **c**. In the first time interval 17 the common background picture 14 is downloaded together with the two audio blocks 15 and 16. These are combined so that programme sub-stream **b** contains the plain background picture 14 plus the audio block 15. Similarly the programme sub-stream **c** contains the plain background picture 14 plus the audio block 16.

At this stage, in this example, there are no other image groups to superimpose on the background; this occurs in the next picture cycle times 18 and 19. In time interval 18 the video stream 1 contains the picture 20 which is made up of two image groups 23 and 24. These two image groups can be superimposed separately on the picture 14 from the previous time interval 17, which has been retained in the memory of the viewer premises equipment, to create either of the pictures 25 or 26 in the potential programme sub-streams **b** and **c** respectively. So if required the image group 23 can be superimposed on the background 14 to form the picture 25 and combined with audio block 21 to form one picture cycle of the programme sub-stream **b** or the image group 24 can be superimposed instead on picture 14 to form picture 26 and combined with the audio block 22 to form one picture cycle of the second programme sub-stream **c**. The same process occurs in interval 19, where either of the two image groups from the picture 27 can be superimposed on the background 14, which is still held in memory, to form either of the potential pictures 30 and 31 in the potential programme sub-streams **b** and **c**. Therefore, although only three pictures have been downloaded within a three picture cycle period, sufficient information has been downloaded for the creation of two discrete programme sub-streams.

The images used as background and for superimposing can be of any level of complexity as long as the final bit-rate for the whole programme stream is within the maximum allowed. The common background image can be changed as required. The background picture would usually be downloaded twice every second to allow for a viewer switching channels not to have to wait too long before a stable image is seen. Figure 3 is a block diagram representation of the data blocks downloaded during the time periods 17 and 18 illustrated in Figure 2. To simplify Figure 3 neither the frame marker block nor a code segment block have been included. During the first picture cycle period 17 the background picture header block 32 is downloaded in the user/private data stream 3 followed by the background picture 14 in the video stream 1. These blocks are followed by the two pairs of audio header and audio blocks 33, 15 and 34, 16. The second time period 18 contains the picture 20 containing the two image groups preceded by its header block 35. This header block contains additional information necessary to identify the location of the various image groups within the picture 20. Also included in this header block are the numbers of separate images included in each image group together with co-ordinate information necessary to identify the location of the various individual images within each image group and the co-ordinate information of the positions in picture 14 where each image will be superimposed. The superimposition co-ordinate information need not be included in this header but could be included in a preceding code segment. The pairs of audio header and audio blocks 36, 21 and 37, 22 are arranged as in the previous picture cycle period 17. The only limit to the number of image groups and the number of images in each group per picture is the size of the picture so it is possible to have more than two potential programme sub-streams. As with the previous embodiment, fewer data blocks could be used and data in a given block could

relate to more that one picture cycle period.

VERSION B

The techniques described in Version A above may be used to generate several potential sub-streams having different backgrounds by staggering the start of the various potential programme sub-streams.

Figure 4 shows how two potential programme sub-streams having different backgrounds may be created. In this figure the relative positions of the various data blocks within the streams represents only one possible arrangement; other arrangements of these data blocks are possible. In Figure 4 the time periods 39, 40, 41 and 42 are each equal to one picture cycle period. Picture 38, which is the first background picture of the sequence, and picture 43, which is the picture containing the first image blocks of the sequence for superimposing on picture 38, are downloaded in consecutive time periods 39 and 40 respectively and stored in memory. While this is occurring pictures 46 or 49 in sub-streams b and c can be displayed. These pictures have previously been downloaded and stored in memory. It is worth noting that only one programme sub-stream may be available during periods 39 and 40. The second background picture 44 is then downloaded during the time period 41 and superimposition can start using the image groups from picture 43 to superimpose on either of the background pictures 38 and 44 resulting in either the combined picture 47 or 50. This process is repeated in the next time period 42 with the background pictures 38 and 44 and the image blocks from picture 45 to produce either picture 48 or 51.

The time period 39 when the background picture 38 is downloaded does not have to be immediately before the time period 40. Neither does the time period 40, when the first

picture containing the image blocks for superimposition 43 is downloaded, have to come immediately before time period 41 which contains the picture with the second background option. These time periods and the time periods 41 and 42 can be separated by considerable time intervals. These pictures can be downloaded when other images can be screened which have previously been held in memory and they are in turn held in memory until required.

VERSION C

The above discussed techniques can be applied to a broadcast system in which the rate at which the pictures are downloaded is fixed (typically 25 or 30 frames a second). This of course is the normal practice. However, there are advantages in dynamically varying the rate at which the pictures are downloaded. This allows more pictures to be downloaded when the information content of the main video stream is low. These extra pictures are not screened but held in memory allowing alternative video streams to be built up. Indeed these pictures can contain image groups which can be superimposed on suitable backgrounds as in Type IIA and IIB above again saving bit-rate. The memory capacity required to store decoded pictures is high. At a frame size of 720 x 576 pixels the information content of a picture would be around 1.1 MB so one second of video with 25 frames would require 27 MB. At present RAM costs, it would not be cost effective to consider more than 64 or 128 MB of RAM for the average domestic television equipment. However improvements in memory design are being made constantly and it will not be long before several gigabytes of RAM will be commonly available in domestic television equipment. At that time, alternative programme sub-streams will be stored in memory as download bit-rates within the programme stream allow.

These extra pictures can also be stored in compressed form i.e. either in the broadcast encoded form which is currently MPEG-2 or any other suitable compressed form. If the MPEG-2 encoded form were chosen an average picture bit content would be 0.15Mbits or 19 KB. In this encoded form a second of video would represent approximately 0.5MB so reasonable amounts of video could be stored to form the basis of alternative programme sub-streams. The storage of large sections of video stream could also be used in technique Type I above.

VERSION D

Compressed images may be downloaded in the private/user data stream which are decompressed and then superimposed on the pictures downloaded in the broadcast encoded video stream.

Referring to Figure 5a, the video stream, audio stream and user/private data streams are represented by the rows 1, 2 and 3 respectively. The relative positions of the various data blocks within the streams represents only one possible arrangement other arrangements of these data blocks are possible. Two time periods are represented, 45 and 46, each being equal to one picture cycle period. In the first period 45 the video stream 1 contains one picture 38 which will act as a common background to two potential programme sub-streams represented by figure 5 **b** and **c**. The private/user data stream 3 contains two image groups 41 and 42, either of these image groups can be superimposed on the background image 38 to form the final potential images 43 and 44 respectively. Combining picture 43 with audio block 39 will give the first picture cycle period of programme sub-stream **b** or combining the picture 44 with the audio block

40 will provide the first picture cycle period of the second programme sub-stream **c**. This is repeated again in time period 46 starting with background picture 47.

Figure 6 represents the data streams which are downloaded in the first time period illustrated in Figure 5 i.e. period 45. The relative positions of the various data blocks within the streams represents only one possible arrangement other arrangements of these data blocks are possible. This figure starts with the frame marker block 43 followed by the software code segment 44 (which may not occur in all picture cycles) in the user/private data stream 3. The next block in the data stream is the frame header block 45 followed by the picture 38 in the video stream 1. The two audio blocks 39 and 40 are each preceded in turn by the appropriate audio block headers 46 and 47 in the data stream. The last two blocks in the figure are the image groups 41 and 42 in the data stream 1. These blocks each contain header sections. These header sections each include amongst other information a section which identifies the block as an image group block and which also contains a unique identifier for that particular image group block. This header section also contains the number of individual images in the image group and their position in the following image data section as well as the co-ordinate information of the positions in picture 38 where each decompressed image will be superimposed. The superimposition co-ordinate information need not be included in this header but could be included in the preceding code segment. This header section is followed by the compressed image data. The controlling software, in response to the viewers selection of the options presented in the interactivity period, selects which of the two image groups 41 or 42 is decompressed and superimposed on the background picture 38. So with this procedure, within

one picture cycle period, which would normally only generate one programme stream, two possible programme sub-streams are available. More than two image groups could be downloaded per picture cycle period to provide more than two possible programme sub-streams. As with the previous embodiments, the number of data blocks may be reduced such that a given data block may contain data relating to more than one picture period.

VERSION E

The use of superimposed image blocks in the user/private data stream as outlined in Type II.D above may be modified such that a single block of images downloaded in the user/private data stream is used to create both potential programme sub-streams. The image block acts as a kind of image toolkit and the controlling software determines how the various images in the image block will be used. The image toolkit may be viewed as a specific example of the image sets of the previous versions.

Referring to Figure 7, the relative positions of the various data blocks within the streams represents only one possible arrangement other arrangements of these data blocks are possible. The two time periods 48 and 49 are each equal to one picture cycle time and the rows 1, 2 and 3 in Figure 7**a** represent the downloaded video, audio and data streams respectively. The background picture 50 in time period 48 is used to create either of the final pictures 58 and 59 in the two potential programme sub-streams **b** and **c**. The image block 53 in the user/private data stream 3 contains four separate images 54, 55, 56 and 57. Three of these images 54, 56 and 57 are superimposed in turn on the background 50 to form the final picture 58

which combined with the audio block 51 forms the first picture cycle period of the potential programme sub-stream of figure 7**b**. The second alternative picture 59 is also formed from superimposing three images from the image block 53 i.e. images 54, 55 and 57. Combining the picture 59 with the audio block 52 produces the first picture cycle period of the second potential programme sub-stream of figure 7**c**. In the second time interval 49 the picture 60 (which is different from picture 50) also acts as a background and again the same image block 53 from time period 48, which has been stored in memory, is used as a source of images to create the alternative programme sub-streams. For the first alternative picture 63 of this time period images 54, 55 and 57 are superimposed on picture 60. When combined with the audio block 61 this forms the second picture cycle period of the first potential programme sub-stream **b**. The images 54, 55 and 57 are superimposed on the background picture 60 to form the alternative picture 64. When combined with the audio block 62 this forms the second picture cycle period of the second potential programme sub-stream **c**. The same images were used to create picture 64 as were used to create picture 59 However, the relative positions of the individual images is different for both pictures. So according to this embodiment, a toolkit of images can be downloaded in the user/private data stream which can be used to create a large variety of final pictures either by selecting different combinations of images from the toolkit or by using the same selection of images but positioning them differently on the background or a combination of both techniques. Of course this toolkit of images could also have been downloaded in the broadcast encoded video stream 1 as in the type 11a and 11d embodiments. Indeed a hybrid system with image toolkits downloaded in both the broadcast encoded video stream and the user/private data stream is also possible. Although

the background used for the two alternative pictures in the first period 48 is different from that used in the second period 49 it is possible to use the same for both so that only one picture is downloaded in the video stream 1 in the first period 48 together with an image toolkit in the user/private data stream 3. Both are stored in memory and used to create the two pairs of pictures 58 and 59 in period 48 and 63 and 64 in period 49.

With this embodiment many picture cycles could be covered with just one background image and one image toolkit. Of course this could be easily extended to provide more than just two potential programme sub-streams as could all of the embodiments described. The toolkits may be retained after use in memory so that a range of toolkits is gradually built up allowing them to be used at a later stage in the broadcast. Alternatively or additionally, algorithms in the controlling software can transform the basic primitive images downloaded in the various toolkits. These algorithms could include the standard transformations of rotation, scaling, reflection and shearing.

Several different pictures are provided from which a background can be selected and one of the above techniques is used to superimpose images on the background to give a variety of potential programme sub-streams.

Referring to Figure 8, the relative positions of the various data blocks within the streams represents only one possible arrangement other arrangements of these data blocks are possible. Data stream 65 represents approximately half a second (at 25 frames/sec) of video stream before MPEG-2 encoding with time periods 70, 71 and

T1 each being equal to four picture cycles. For this example the video stream is made up of three groups of identical pictures i.e. four A type pictures, four B type pictures and four C type pictures. The data stream 66 represents video stream 65 after MPEG-2 encoding with the added suffix indicating whether the picture is an I, B or P type. The lower data streams 67, 68, and 69 represent the potential video streams that can be created from the downloaded video stream 66. In the case of video stream 67 the background selected is picture A and so A is retained in memory for the additional two time periods 71 and 72 so that it can be used as the background throughout periods 70, 71 and 72. For video stream 68 picture B has been selected as the background but for the first time period 70 picture X, which comes from another section of the programme and has been held over in memory, has been used as a background until a picture B is downloaded. After picture B has been downloaded it is used as a background for period 71 then held over in memory for period 72 and for further periods if required. The same procedure is followed, staggered by one time period, for the potential video stream 69. Now since blocks of identical images have been encoded the download bit-rate will be quite low and advantage can be taken of that to download images in the data stream to be superimposed on the selected background (as described in methods Type II.D and Type II.E above) to provide the final programme sub-stream. An example of combining this technique with that described in Type II.D above is illustrated in Figure 9 where the top row 73 represents a video stream and is composed of 19 pictures. The first picture P is used as a preparation for the interaction sequence and is presented to the viewer while other pictures are downlinked. Of the remaining pictures there are three type R, three type S , three type T etc. The use of the prime over the second set of nine pictures is to indicate that they could, if necessary, be variants of the first set of nine. The

user/private data stream 74 is made up of three staggered sequences of image groups A, B and C with each member of the sequence different if necessary. Three distinct programme sub-streams 75, 76 and 77 can be created from these sequences of pictures and image groups by superimposing each image group on the appropriate background picture i.e. in programme sub-stream A after an initial picture cycle where picture P is presented image group A/1 in the user/private data stream, after decoding, is superimposed on the background picture R. This is repeated in turn with each image group. If programme sub-stream 77 is required this is created after seven picture cycles with picture P being presented followed by image group C/1 superimposed on picture T and so on. This is a method, according to the invention, where multiple background pictures are available without requiring that a large number of pictures are held in memory. The choice of four identical pictures of each type for this example was purely arbitrary, as was the number of different picture types and the half second time period. According to this invention the number of pictures of the same type used and the number of different types of picture used are determined mainly by the total maximum bit-rate allowed.

A common point about all the methods described above is that the images used as background and for superimposing can be of any level of complexity as long as the final bit-rate for the whole programme stream is within the maximum allowed.

It is possible to use hybrids of all of the above techniques.

In versions D, E and F of the Type II embodiment, use has been made of the user/private data stream to download control information and image groups etc. In certain circumstances it may be possible to use the MHEG stream as

well as or instead of the user/private data stream to download such data. This will depend on the facilities required by the television programme. It may also be possible in time to use the MHEG-5 engine to do some or all of the controlling of this system it will depend on how the MHEG-5 system develops.

The range of techniques of creating multiple programme sub-streams described above could be implemented with a sufficiently powerful Application Programming Interface (API) provided with the third party decoding hardware as long as a sufficiently powerful central processor was available together with adequate spare memory in the third party hardware.

There is a range of techniques that can be applied to any of the above types of interactivity to increase their flexibility. This may include the provision for continuous panning over a background image when there is only one video stream available and several different backgrounds are required i.e. a different background for two or more programme sub-streams. This technique is based on using the first picture of the panning sequence to act as the basis for the second and the second for the third etc. with the first being converted into the second by adding two rectangular sections onto the first picture where these rectangular sections are the differences between the two pictures. This is shown in Figures 10 and 11.

In Figure 10, picture 79, in the first row, is the first picture of the panning sequence across the background 78 and 80 being the second picture of the panning sequence. Picture 80 has been panned both horizontally and vertically. The second row of images in Figure 10 illustrates how picture 79 can be transformed via image 81 into the second picture 80. This is achieved

by adding the two rectangles 83 and 84 to picture 79 to form picture 81 then moving the origin from the top left hand corner of the combined image 81 to the position 82. The two rectangles 83 and 84 then represent the differences between picture 79 and 80. At the bottom of Figure 10 are the two rectangles 83 and 84 which are all that have to be downloaded, together with the new co-ordinates of the origin, after picture 79 to create picture 80. Therefore, for example, with a panning sequence of 10 pictures all that would need to be downloaded would be the first picture plus the ten sets of two rectangles which would be added sequentially to the first picture to create the remaining nine pictures. These ten sets of rectangles could be packaged into a small number of pictures with perhaps all the vertical rectangles in one or more pictures and all the horizontal ones in another one or more pictures.

For a automated system to isolate these pairs of rectangles it is necessary to determine the shift in the origin co-ordinates between the two pictures or the displacement vector. If the background is computer generated this information is known, otherwise a method, embodying a further aspect of the invention, can be used which is illustrated in Figure 11. The normal choice of origin for computer monitors etc. is the top left-hand corner, however, for the purposes of this search routine it is more efficient to use the centre of the screen. So the first picture is considered 85 and a square 86, centred on the screen centre or origin is chosen to define the area in which the origin of the second picture has been moved to. The size of this square should obviously be sufficient to include the new origin and should therefore reflect the panning speed. For most purposes, with a screen size of 720 x 576 pels, a square of side 128 pels would be adequate for most panning rates. The search procedure starts by taking one pel within that square as

the putative origin of the second picture and comparing the colour of that pel with the pel at the centre or origin of the second picture 88. The method of representing the colour can be based on any of the standard methods such as YCbCr, RGB, HSL etc. One suitable method of making the comparison is by squaring the difference between the values e.g. $(Y1-Y2)^2$, $(C_b1-C_b2)^2$ and $(C_r1-C_r2)^2$ (NB there are other methods available). This comparison of the colour of a pel in the first picture with one in the second is continued, always using the putative origin in the first picture as the basis of the co-ordinate system on which to base the comparison and the squared differences added to the appropriate previous sum producing three sums:

$\sum(Y1-Y2)^2$, $\sum(C_b1-C_b2)^2$ and $\sum(C_r1-C_r2)^2$. The number of pels compared will depend on the type of background picture but a number of around 1/64th of the total would not be unreasonable (6.5K). In Figure 11 pattern 87 represents a useful arrangement of pels, in the first picture 85, to use for the comparison and pattern 89 shows the equivalent pattern in the second picture 88. This comparison will result in three sums of squared differences

$\sum(Y1-Y2)^2$, $\sum(C_b1-C_b2)^2$ and $\sum(C_r1-C_r2)^2$. for the point selected in the first picture as the putative centre of the second picture relative to the first.

This comparison is then repeated for all the pels in the search square 86 producing a series of sets of the three squared differences for each pel. When these sets of values are examined there should be significant minimum values for all three colour values at the correct origin thus defining the displacement vector(It is possible that no significant minimum's are evident in which case this method cannot be applied). Once the origin of the second

picture relative to the first or the displacement vector has been established the co-ordinates of the two rectangles can be easily determined by simple co-ordinate geometry (NB the displacement vectors can also be obtained by using other appropriate techniques such as artificial intelligence systems). The same procedure can be applied to the third picture in the sequence compared with the second and so on. Thus, several pictures in the panning sequence can be derived from adding the pairs of rectangles sequentially to the first picture. All that is needed to be downloaded is the first picture of the sequence plus the co-ordinates of the origins relative to the previous picture in the sequence and all the rectangles. All the vertical rectangles can be grouped together to form one or more pictures and similarly all the horizontal rectangles can be grouped together in the same way. Therefore a panning sequence of several pictures can be reduced into a much smaller number of pictures so that several continuous panning sequences can be produced from the same number of pictures or less normally required to produce only one continuous panning sequence. To simplify the development of a panning sequence the PDE can automatically derive the whole sequence if provided with an image which covers the whole field of view from the start to the finish of the panning sequence together with the start and finish co-ordinates and the number of pictures required. A panning sequence prepared in this way can either be the full sequence of pictures or as the condensed version described above.

In another possible modification, where simple changes in colour are required in an easily defined area of an image a software algorithm can be included in the controlling software to carry out the colour change without downloading a replacement image if this provides a

significant reduction in broadcast bit-rate.

As an alternative to combining the background images with image portions it is possible to combine the background image with one of a selection of possible audio tracks. These may be distributed in the user/private data stream and/or in the audio stream. Thus, for example, the background image could be a map and the programme sub-streams are various levels of instruction regarding that map.

Currently the major factors limiting the type and extent of the interactivity which can be provided by this invention are the maximum available bit-rate and the size and speed of the memory available in the typical domestic television equipment. In the near future far higher frequency bands will be used for commercial television broadcasts which is likely to result in higher bit-rates becoming available for domestic television. Memory is also becoming significantly cheaper and faster so within a year or so it will be common to find gigabyte memory sizes in domestic equipment. Improvements of this type in technology will make it much easier to take full advantage of the technology provided by this invention.

Figures 12 to 15 illustrate the hardware and software required to implement the various embodiments described. Much of this is already commercially available.

Figure 12a shows the most common configuration that will be available initially for the reception and presentation of digital television broadcasts. A set top box or integrated receiver/decoder (IRD) 90 has an input RF signal input 91 from cable, satellite or terrestrial television broadcasts. After the RF signal has been demodulated, demultiplexed and decoded it is converted to

PAL, NTSC or equivalent to be outputted to the analogue television 92. The first IRD's to be marketed are unlikely to have sufficient spare memory and microprocessor capacity to be able to cope with the demands of the technology provided by this invention. This is likely to change in time and the more powerful IRD's will be able to process television broadcasts which incorporate the type of interactivity provided by the embodiments of this invention in several ways which include the API provided by the service provider being extended to incorporate this technology; thus they will have to handle:

additional code segments included in the user/private data stream to specifically supplement the existing API; the use of the MHEG system in whole or in part; or code segments in the user/private data stream which completely control the IRD's central processor's handling of the various data streams.

In any of these cases some IRD/chip designs may enable access to the video and audio streams after depacketizing but before decoding so that the streams can be stored in memory still in compressed form. Therefore, allowing storage of far higher quantities of video and audio data. However, initially, additional memory and processing power will have to be provided by other means such as a computer (IBM compatible computer, Apple Mac etc.). Figure 12b illustrates such a configuration with an IRD 90 linked to a computer 94 via a high speed digital link (IEEE 1394 or similar) 93. In this configuration the IRD will carry out the demodulation, demultiplexing and the decoding and an add-on high speed digital interface module (IEEE 1394 or similar) in the IRD will be configured to provide a suitable digital output to link to a high speed digital interface (IEEE 1394 or similar) in the computer. The television programme will be presented using the computer's monitor and loudspeakers under the

control of software provided by the various embodiments described which will perform the following functions:

the input of data from the IRD;
determination if the broadcast is utilising the technology provided by embodiments of this invention;
processing the various blocks of data as defined by the appropriate header blocks and the downloaded software. This will involve transferring some blocks for immediate presentation to the viewer, transferring others to main memory, transferring blocks from main memory for presentation to the viewer or in the case of some video blocks for superimposition (possibly with prior decoding) on other video blocks before presentation to the viewer;
in response to the downloaded software and/or header blocks, setting up the interactive areas in the programme and log the viewers' responses;
comparing the viewers' responses (via the computer's keyboard) with those downloaded in the broadcast and as a result of the comparison selecting and preparing appropriate programme sub-stream;
presenting the appropriate programme sub-stream;
at the end of the broadcast, closing down the system and handing over to normal broadcasting after optionally providing the viewer with a summary of their results.

Figure 12c illustrates another configuration involving a computer. This is similar to the configuration illustrated in Figure 12b except that the computer returns the processed data to the television for presentation. The data streams are conveyed from the IRD 90 to the computer 94 by a high speed digital link (IEEE 1394 or similar) 95. The computer processes the data and returns it to the IRD via another high speed digital link (IEEE 1394 or similar) 96. The IRD then carries out the normal data conversion to

PAL or equivalent and this is passed to the analogue television 92 for presentation. The computer software B provided by this invention will control the following functions:

the input of data from the IRD;
determination of whether the broadcast is utilising the technology provided by embodiments of this invention;
determination of whether the data streams are part of interactivity sequences, if not the data streams are re-routed directly back to the IRD otherwise the processing by the computer continues;
processing the various blocks of data as defined by the appropriate header blocks and the downloaded software. This will involve transferring some blocks for immediate presentation to the viewer back to the IRD, transferring others to main memory, transferring blocks from main memory back to the IRD for presentation to the viewer or in the case of some video blocks superimposition (possibly with prior decoding) on other video blocks before transferring back to the IRD for presentation to the viewer.
in response to the downloaded software and/or header blocks setting up the interactive areas in the programme and logging the viewers' responses;
comparing the viewers' responses (via the computer's keyboard) with those downloaded in the broadcast and, as a result of the comparison, selecting and preparing the appropriate programme sub-stream;
transferring the appropriate programme sub-stream to the IRD;
at the end of the broadcast, closing down the system and handing over to normal broadcasting after optionally providing the viewer with a summary of their results.

Figure 13a illustrates an equipment configuration where the IRD 90 is connected via a high speed digital

link (IEEE 1394 or similar) 97 to an additional data processing unit 98 provided by this invention. This control unit 98 will process the data in a similar fashion to the computer in the equipment configuration illustrated in Figure 12c although in this case the viewer uses an a hand-held unit 100 (preferably via infra-red transmissions although other appropriate methods will suffice) to distribute the choices to the control unit 98. An overall block diagram of an example control unit is shown in Figure 15. The main input to the control unit comes from the viewers' IRD via a high speed digital link into a high speed digital interface module 112 (IEEE 1394 or similar). The RAM 114 contains the control software provided by this invention which controls the processing unit 113. This control unit will control the following functions:

the input of data from the IRD;
determination of whether the broadcast is utilising the technology provided by this invention;
determination of whether the data streams are part of interactivity sequences, if not the data streams are re-routed directly back to the IRD, otherwise the processing by the control unit continues;
processing the various blocks of data as define by the appropriate header blocks and the downloaded software. This will involve transferring some blocks for immediate presentation to the viewer back to the IRD through the interface 116, transferring others to RAM 114, transferring blocks from RAM 114 back to the IRD through the interface 116 for presentation to the viewer or in the case of some video blocks superimposition (possibly with prior decoding) on other video blocks before transferring back to the IRD for presentation to the viewer;
in response to the downloaded software and/or header blocks setting up the interactive areas in the programme

and logging the viewers' responses which are inputted via the infra-red receiver 118;
comparing the viewers' responses with those downloaded in the broadcast, and, as a result of the comparison,
selecting and preparing the appropriate programme sub-stream;
transferring the appropriate programme sub-stream to the IRD via the interface 116;
at the end of the broadcast closing down the system and handing over to normal broadcasting after optionally providing the viewer with a summary of their results;
the smart card reader 117 provides conditional access facilities if required.

Figure 13b illustrates an equipment configuration where a digital television is connected via a high speed digital link 102 (IEEE 1394 or similar) to an additional data processing unit 103 which processes the data input from the digital television and returns it via the high speed digital link 104 (IEEE 1394 or similar). This control unit behaves in exactly the same way as the control unit illustrated in Figure 13a and the overall block diagram of the example control unit illustrated in Figure 15 can be applied to this control unit.

Figure 13c illustrates an equipment configuration where a digital television is linked to a computer. This configuration has the same technical features as the configuration illustrated in Figure 12c where the digital television functions in the same way as the IRD plus analog television.

An alternative configuration is a computer fitted with a PCB with of all the features of an IRD. This would perform in the same fashion as the equipment configuration illustrated in Figure 12a.

A further equipment configuration is a stand-alone digital television which will have the processor capacity and memory capacity to operate in the same fashion as the equipment configuration illustrated in Figure 13b.

The system and methods described are particularly suited to educational broadcasts in which system users submit answers to questions. Based on the answers, or an overall assessment of the user's ability based on answers to a number of questions, the receiver will decide which programme sub-streams should be assembled and presented to the user. This may be a simple choice between two sub-streams, or a more complex choice involving different portions of a number of sub-streams. In this respect, the user is interacting with the receiver and not with the programme distributor. The content of the broadcast received at the receiver does not change but the manner in which the receiver interprets and assembles the received data for presentation to the user will change according to the interactivity with the user. Thus, the embodiments described may be used to provide a very powerful educational tool.

It follows that the receiver must be programmed in order to assemble the material for presentation. This may be done through software distributed by the broadcaster in the private/user data stream or may be pre-programmed. For example on a smartcard. Where the user is following an educational course a series of smartcards may be provided relating to different parts or modules of the course.

The receiver will, one way or the other, store a database of information allowing it to compare inputs from the user and, on the basis of that comparison, select the appropriate sub-stream for presentation at a given time. This database may include, for example, all the correct

responses to a series of questions and the control software is able to analyse the number of correct responses or the type of question the user answers correctly and determine which sub-stream is appropriate to present at any given time.

When a user joins an interactive broadcast, by selecting the appropriate channel, a still image will first be displayed while the necessary background image(s) and image sets are downloaded. If the user has joined during an interactive sequence after the start, then only the default image, or a default sub-stream, will initially be presented until the start of the next interactive sequence. This will also occur if the user has joined before the start of the interactive sequence but has not provided a complete response.

It will be appreciated that as the interactivity is with the receiver, and not the broadcaster, the broadcast can be recorded off-air and the interactivity will still function when the recording is played back.

Other modifications and developments to the methods and systems described are possible without departing from the scope of the invention which is defined by the claims appended hereto.

CLAIMS

1. A method of distributing an interactive broadcast video programme comprising distributing a video stream having frames of at least one background image, and distributing an associated control data stream, wherein at least one of the control data stream and the video stream further includes streams of image sets comprising at least one image portion, and the control data stream includes instructions for combining one or more portions of the image sets with the background image to produce a plurality of possible video sub-streams.

2. A method according to claim 1, further comprising distributing frames of audio data associated with the background image and the portions of the image sets.

3. A method according to claim 2, where the audio data is at least partially distributed as a separate audio stream.

4. A method according to claims 1 or 2, wherein the audio data is at least partially distributed in the control data stream.

5. A method according to any of claims 1, 2, or 3 wherein the video stream comprises a plurality of background images and the control data stream includes instructions for combining portions of each frame of image sets with each of said background images to produce the plurality of possible image sub-streams.

6. A method according to any of claims 1 to 5, wherein the instructions for combining portions of each frame of image sets with the one or more background images include

an identification of the portion of the image set to be combined and the position on the background image of the image set portion.

7. A method according to claim 6 wherein a plurality of background images are available and wherein the combining instructions further include an identification of the background image.

8. A method according to any of claims 1 to 7 wherein the image sets comprise a kit of image portions and the combining instructions include instructions for selecting which of the kit of image portions are to be selected and the position of each selected portion on the background image.

9. A method according to any of claims 1 to 8 wherein a plurality of successive picture periods of the video stream include a common background image and each frame of the common background image after the first is encoded by a different coding method, comprising distributing image sets in the video data stream in each of the picture periods in which the common background image is distributed after the first picture period of said common background image.

10. A method according to any of claims 1 to 9, comprising dynamically varying the rate at which frames of background images and frames of image sets are distributed.

11. A method according to any of claims 1 to 10, wherein a plurality of background images are distributed in the video stream and representing a panned background, the method comprising distributing the first frame of the background and for each subsequent background frame

differences from a previous frame together with coordinates of the origin of the frame.

12. A method according to claim 11, wherein the origin of each frame of background after the first is determined by selecting an area of the image in which the origin should occur and comparing the colour of pixels of that area with the colour of the origin of a previous background frame.

13. A method according to any preceding claim, wherein the control data stream is a user or user/private data stream.

14. A method according to any of claims 1 to 17, wherein the control data stream is an MHEG stream

15. A method according to any preceding claim, wherein distributed video data is MPEG-2 encoded.

16. A method of distributing an interactive broadcast programme, comprising distributing a stream of programme material and a stream of associated control data, wherein the stream of programme material includes at least one programme sub-stream and wherein at least one further programme sub-stream is distributed in either the programme material stream or the data stream.

17. A method according to claim 16, comprising distributing a further programme material stream, wherein one of the programme material stream and the further programme material stream comprises video information and the other of the programme streams comprises related audio information.

18. A method according to claim 16 or 17 wherein the further programme sub-stream is distributed in the stream of programme material, the method comprising distributing

a frame of programme material of each programme sub-stream in each broadcast frame period.

19. A method according to any of claims 16 to 18, wherein the broadcast programme has a first distributed data rate and the first and second programme sub-streams are encoded at a combined data rate less than or equal to the first distributed data rate.

20. A method according to any of claims 16 to 19 wherein the control data stream comprises programme sub-stream identifier for signalling to which programme sub-stream a given block of programme data belongs.

21. An encoded signal carrying interactive programme material comprising a stream of programme material and a stream of control data, wherein the stream of programme material includes at least one programme sub-stream and at least one of the programme material and data streams, includes at least one further programme sub-stream.

22. A video signal modulated to carry an interactive video programme comprising a stream of video data having frames of at least one background image and a control data stream, wherein at least one of the control data stream and the video stream includes instructions for combining portions of the image set with the background image to produce a plurality of possible video sub-streams.

23. Apparatus for distributing broadcast programme material comprising means for distributing a stream of programme material including at least one programme sub-stream and means for distributing a stream of associated control data wherein one of the means for distributing a stream of programme material and the means for

distributing associated control data includes means for distributing at least one further programme sub-stream.

24. Apparatus for distributing interactive broadcast video programme material comprising means for distributing a video stream having frames of at least one background image, and means for distributing an associated control data stream, wherein one of the distributing means further comprises means for distributing frames of image sets and the control data stream includes instructions for combining portions of the image sets with the background image to produce a plurality of possible video sub-streams.

25. Apparatus according to claim 24, further comprising means for distributing frames of control data associated with the background image and the portions of the image sets.

26. Apparatus according to claim 25 wherein the audio data distributing means includes means for distributing a separate audio stream.

27. Apparatus according to claims 24, 25 or 26 wherein the video stream distributing means comprises means for distributing a plurality of background images and the control data stream distributed by the control data distributing means comprises instructions for combining portions of each frame of image sets with each of said background images to produce the plurality of possible image sub-streams.

28. Apparatus according to any of claims 24 to 27 wherein the means for distributing image sets comprise means for distributing kits of image portions and the control data means includes means for sending instructions for selecting which of the kit of image portions are to be

selected and the position of each selected portion on the background image.

29. Apparatus according to any of claims 24 to 28 wherein the video stream distributing means distributes a plurality of frames of a common background image and comprises means for difference coding each frame of the background images after the first and means for distributing image sets in the video stream during picture periods in which difference coded background pictures are distributed.

30. Apparatus according to any of claims 24 to 29, comprising means for dynamically varying the rate at which frames of background images and image sets are distributed.

31. Apparatus according to any of claims 24 to 30, wherein the video stream distribution means includes means for distributing a sequence of background images representing a panned scene, comprising means for distributing the first image of the scene and means for distributing the difference between subsequent images and a previous image together with coordinates of the origin of the subsequent image.

32. Apparatus according to claim 31 wherein the video distribution means comprises means for determining the origin of subsequent images in a panned sequence by comparing an attribute of pixels of a selected area of an image with the same attribute of the origin of the previous background image.

33. A system for distributing and receiving and interactive broadcasting programme comprising, at a distributor, means for distributing a stream of programme

material including at least one programme sub-stream and means for distributing a stream of associated control data, wherein one of the means for distributing a stream of programme material and the means for distributing associated control data includes means for distributing at least one further programme sub-stream;
and at a receiver:
means for selecting one of the received programme sub-streams for presentation or storage.

34. A system for distributing and receiving an interactive broadcast programme comprising, at a distributor: means for distributing a video stream having frames of at least one background image, and means for distributing an associated control data stream, wherein one of the distributing means further comprises means for distributing frames of image sets and the control data stream includes instructions for combining portions of the image sets with the background image to produce a plurality of possible video sub-streams;

and at a receiver:
means for receiving the distributed programme material; and

means for selecting one of the possible programme sub-streams including means for assembling the selected sub-stream from the received background image and image sets in accordance with the instructions in the received control data stream.

35. A system according to claim 34, wherein the receiver comprises a memory for storing frames of background images.

36. A system according to claim 35 wherein the distributed image sets include sets of image parts and the receiver includes a memory for storing a library of received image parts.

37. A receiver for receiving an interactive broadcast programme comprising means for receiving a stream of programme material, and means for receiving a stream of associated control data; wherein the stream of programme material includes at least one programme sub-stream, and wherein one of the received stream of programme material and associated control data includes at least one further programme sub-stream,

means for selecting one of the received programme sub-streams for presentation or storage, and means for extracting from the received programme material stream and control data stream the selected programme sub-stream in accordance with the received instructions in the control data stream.

38. A receiver for receiving an interactive broadcast video programme, comprising means for receiving a video stream having frames of at least one background image, means for receiving an associated control data stream, means for receiving image sets distributed in one of the video and control data streams, means for selecting a programme sub-stream for display or storage, and means for assembling the selected sub-stream from the received background image and image sets in accordance with the instructions in the received control data stream.

39. A receiver according to claim 38 wherein the received programme material includes a plurality of background images, the receiver comprising a memory for storing at least one background image.

40. A receiving according to claim 38, wherein the received image sets comprise image tool kits, the receiver comprising a memory for storing a library of image tool kits.

41. A receiver according to claim 38, 39 or 40, wherein the receiver further comprises means for recognising reception of an interactive broadcast.

42. A receiver according to any of claims 38 to 41, comprising control means for acting on blocks of received interactive programme data to transfer a first set of blocks for immediate display or long term storage, a second set of blocks to a memory, and a third set of blocks from memory to display as long term storage.

43. A receiver according to any of claims 37 to 42 wherein the receiver comprises an integrated receiver/decoder (IRD), a display means and a further processor.

44. A receiver according to claim 43, wherein the processor is coupled to the display.

45. A receiver according to claim 43, wherein the processor is coupled to the IRD.

46. A receiver according to any of claims 37 to 45 comprising a memory having stored therein programme data relevant to the programme material, and the selecting means comprises means for comparing interactive user inputs to the receiver with selected data stored in said memory, and means for determining which programme sub-stream is to be presented to the user at any given time based on the results of the comparison.

47. A receiver according to claim 46, wherein the determining means operates under the control of software received in the control data stream.

48. A receiver according to claims 46 or 47 comprising means for loading data for storage in said memory.

49. A receiver according to claim 48 wherein said loading means comprises a smartcard.

50. A receiver according to claim 49 wherein said smartcard further has stored thereon software for controlling operation of the determining means.

51. A method of distributing an interactive broadcast video programme, comprising distributing a video stream having frames of at least one background image, and distributing an associated control data stream, wherein audio data is also distributed and the control data stream includes instructions for combining selected audio data with the background image to produce a plurality of possible programme sub-streams.

52. A method according to claim 51 wherein the audio data is distributed at least partially, in the control data stream.

53. A method according to claim 51 or 52, wherein the audio data is distributed at least partially in a separate audio stream.

54. A method of determining the origin of a video image comprising acquiring video data of a previous related image having a known origin, selecting a portion of the new image in which the origin is likely to fall, comparing an attribute of the pixels within the selected portion with the same attribute of the origin of the previous related image, and determining a given pixel of the selected area to be the origin when the comparison shows the attributes to have the same value.

55. A method according to claim 54 wherein the attributes are pixel colour.

56. A method according to claim 54 wherein the new image is a horizontally and/or vertically displaced version of the previous related image.

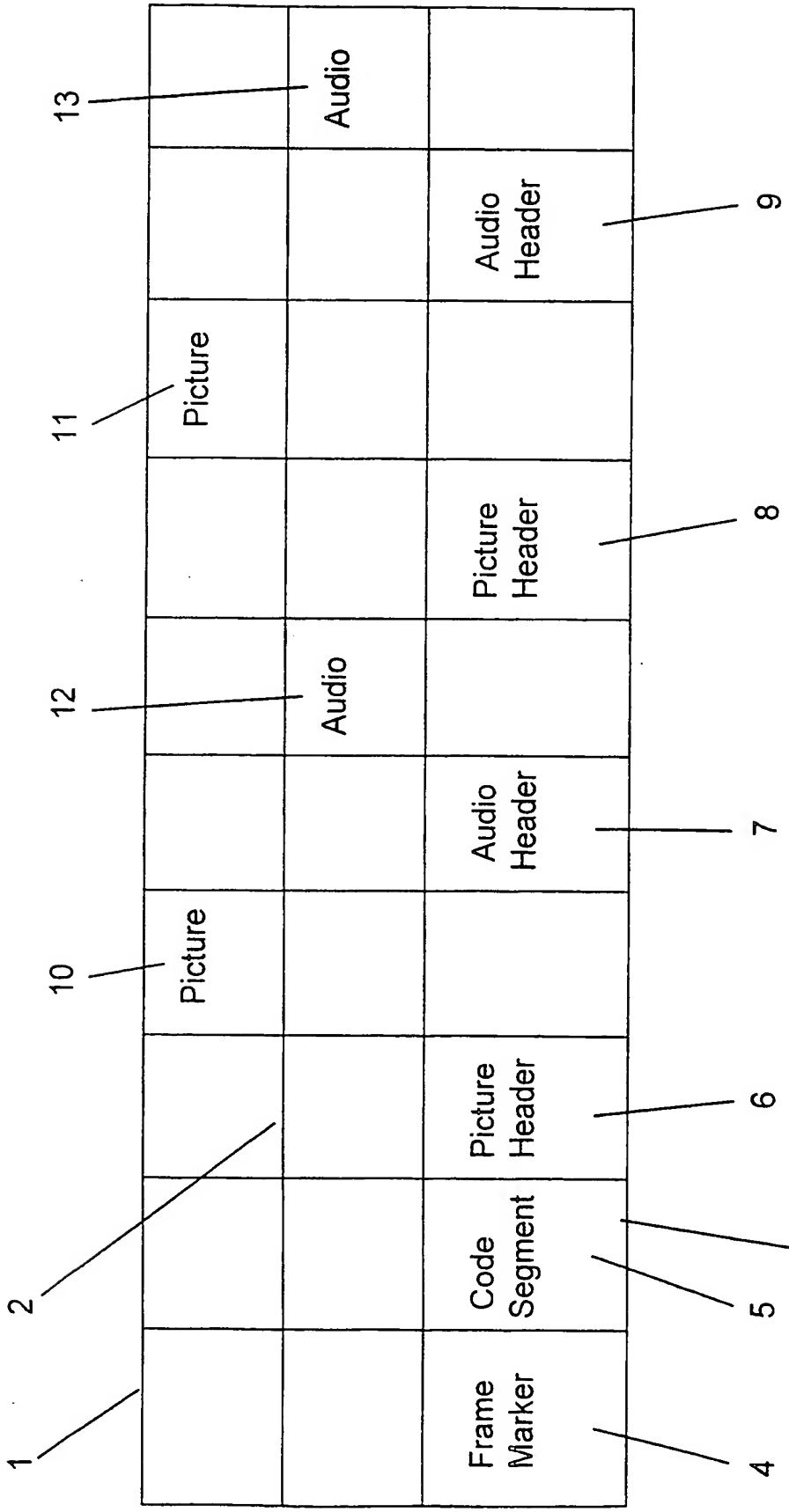
Frame Marker
Code Segment
Picture Header
Picture
Audio Header
Audio
Picture Header
Picture
Audio Header
Audio
1
2
3
4
5
6
7
8
9
10
11
12
13

Figure 1

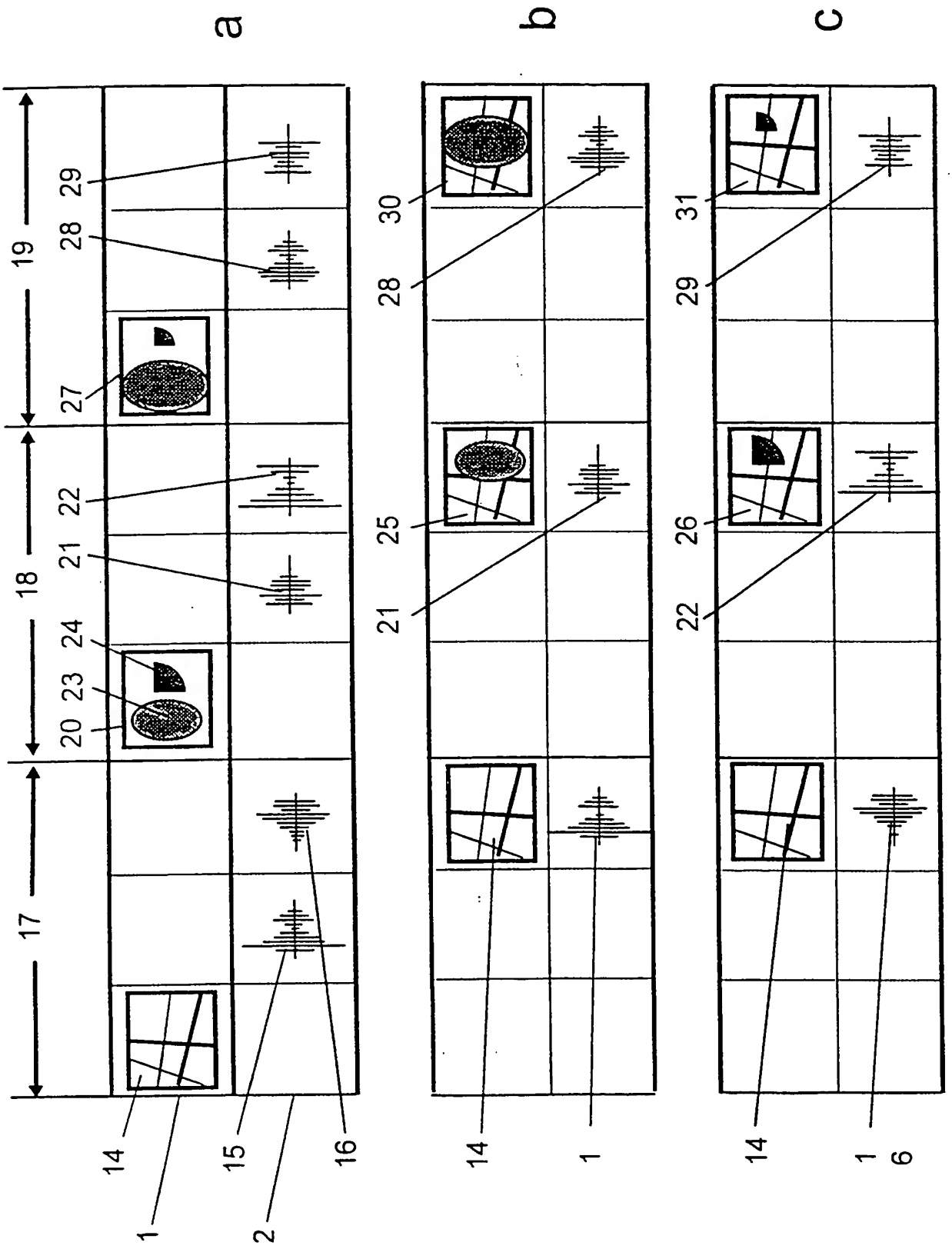

Figure 2

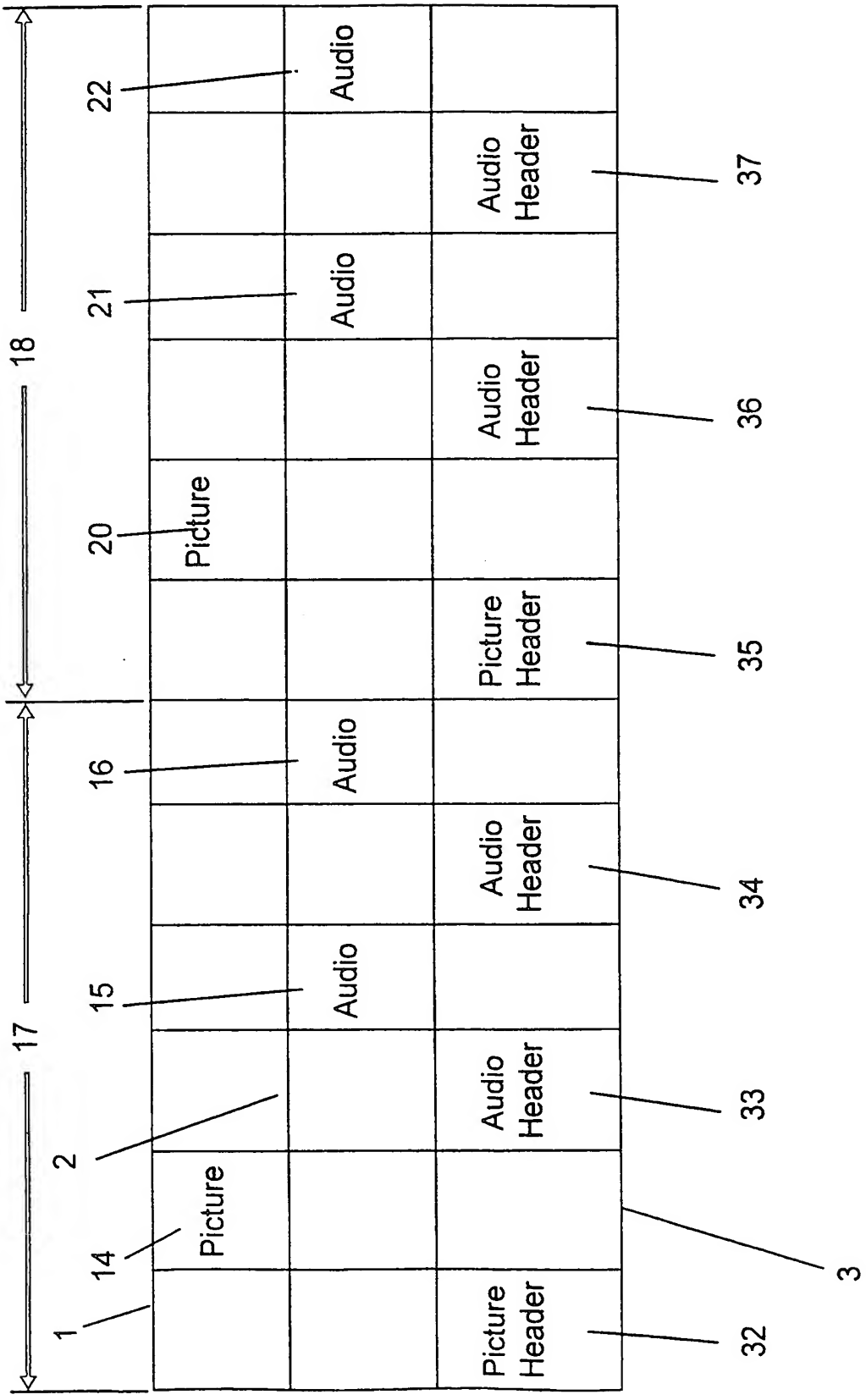
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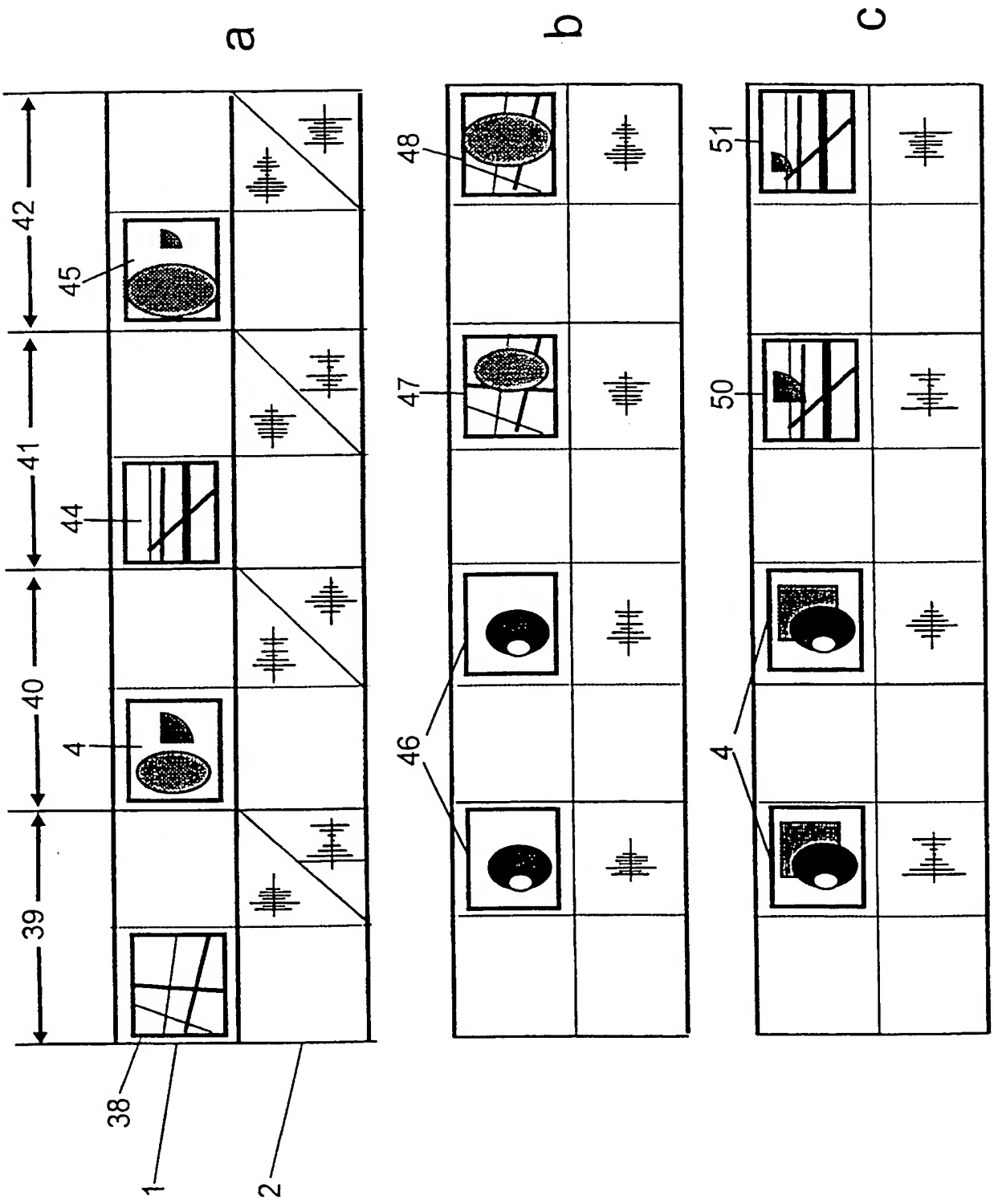
Figure 3



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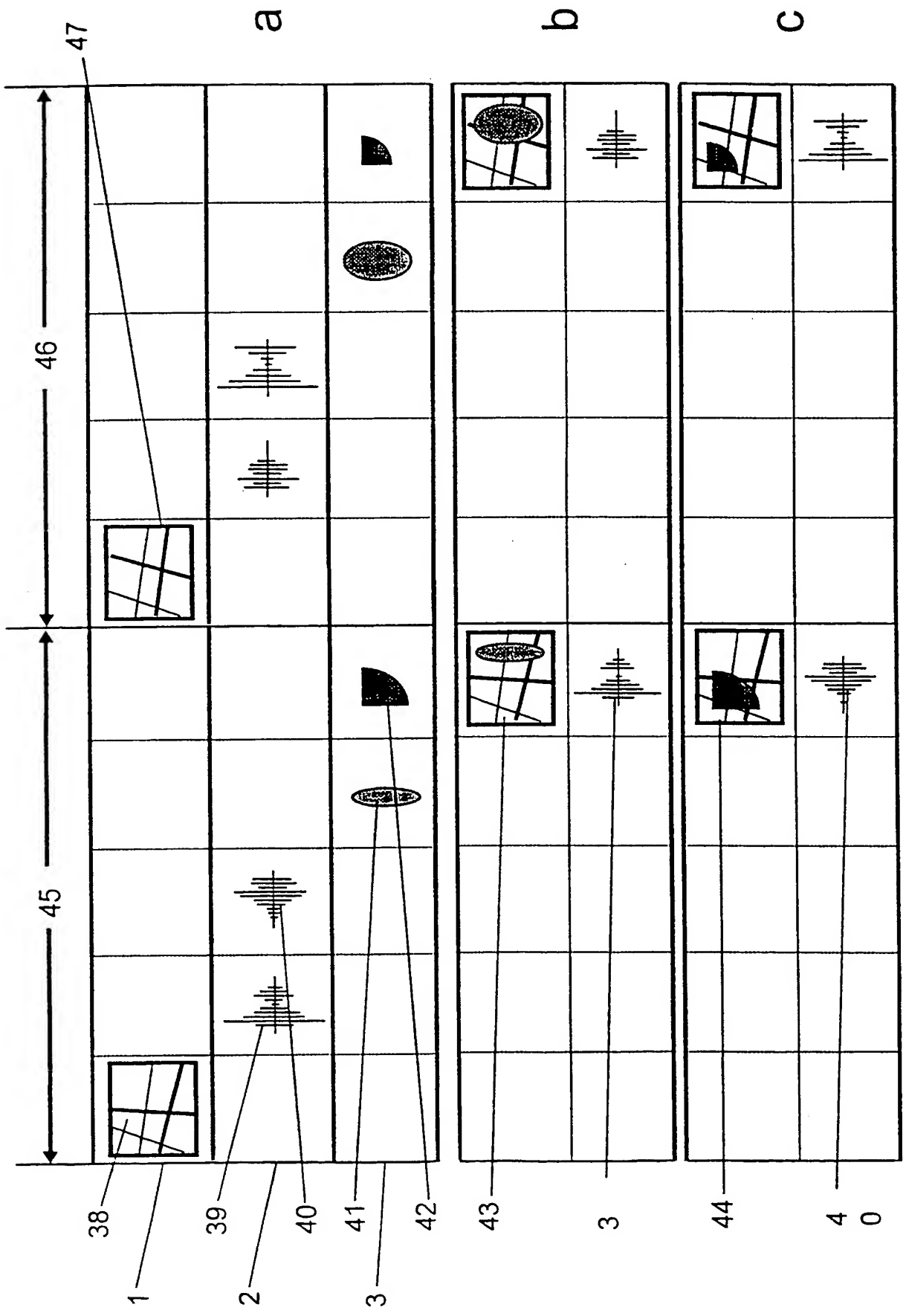

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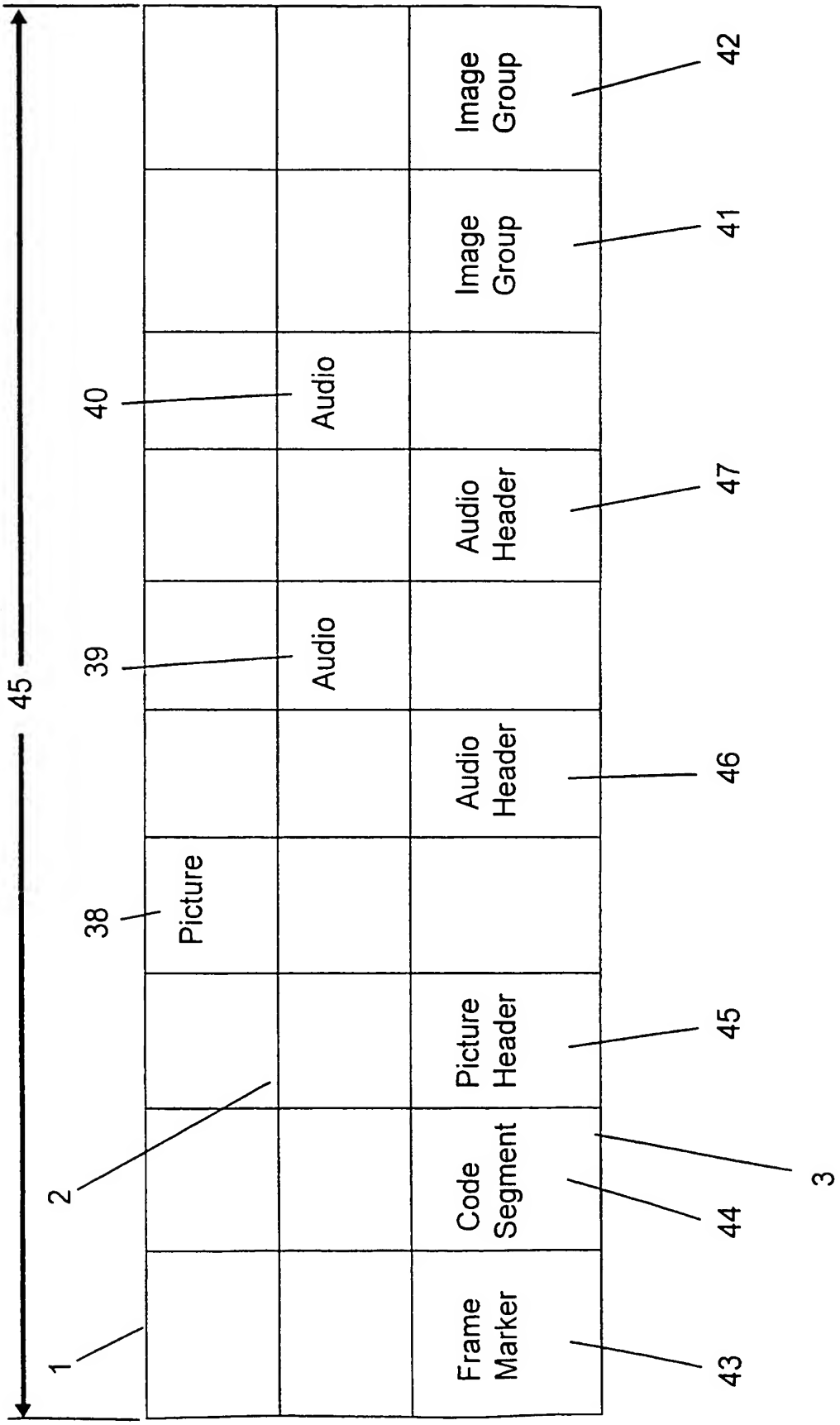
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Code Segment
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Audio Header
Audio Header
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Image Group
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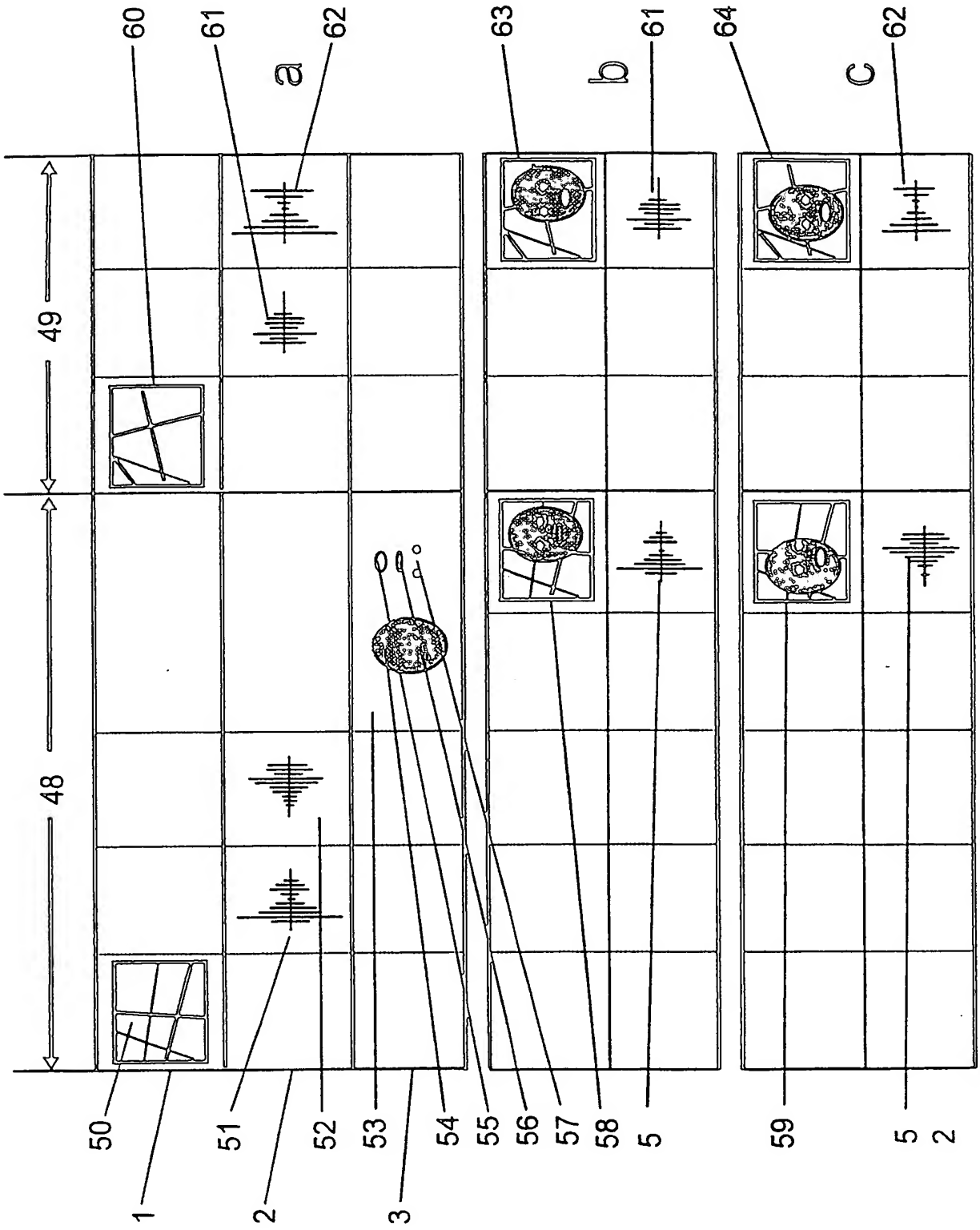
Figure 6



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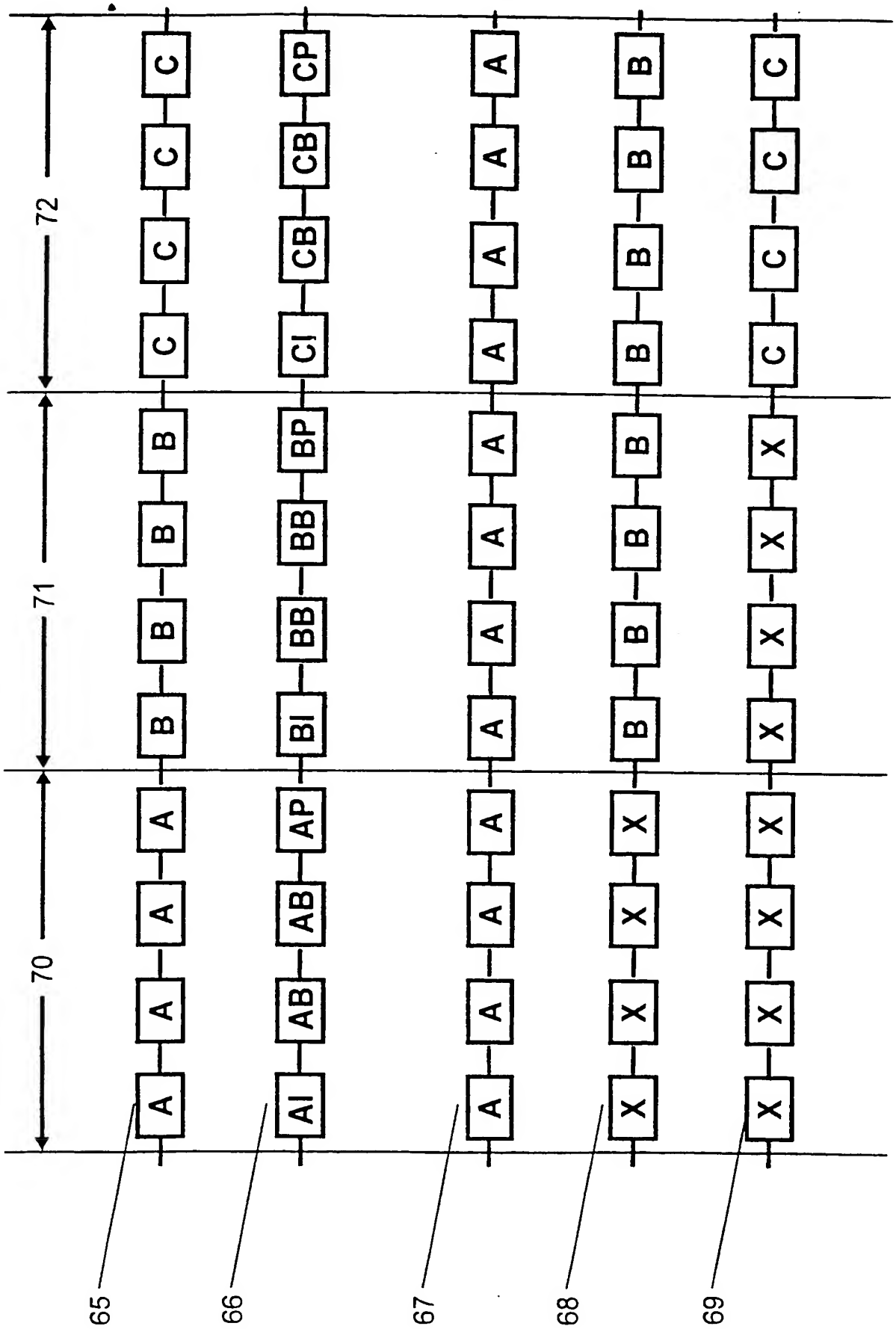
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Figure 8

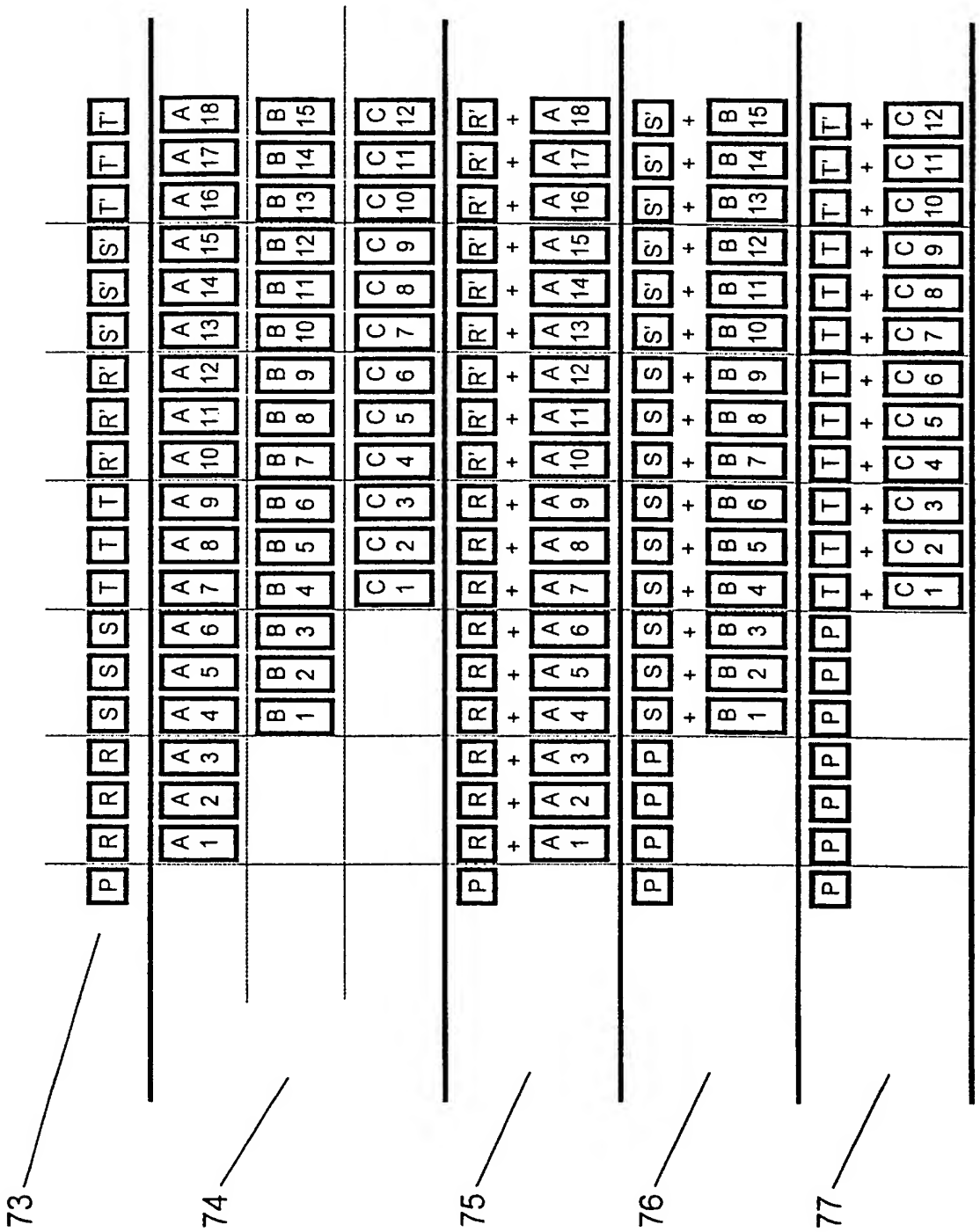

Figure 9

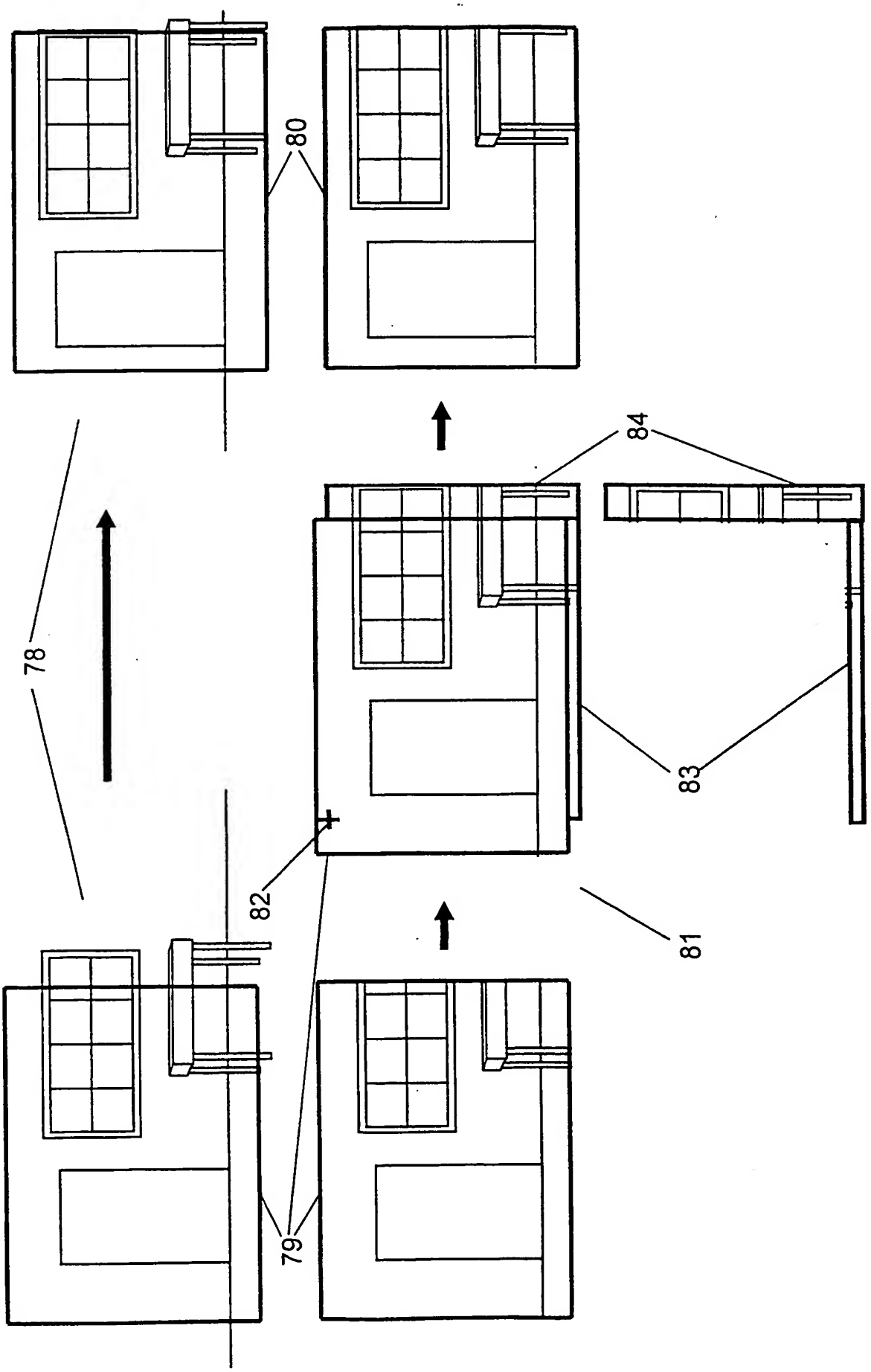

Figure 10

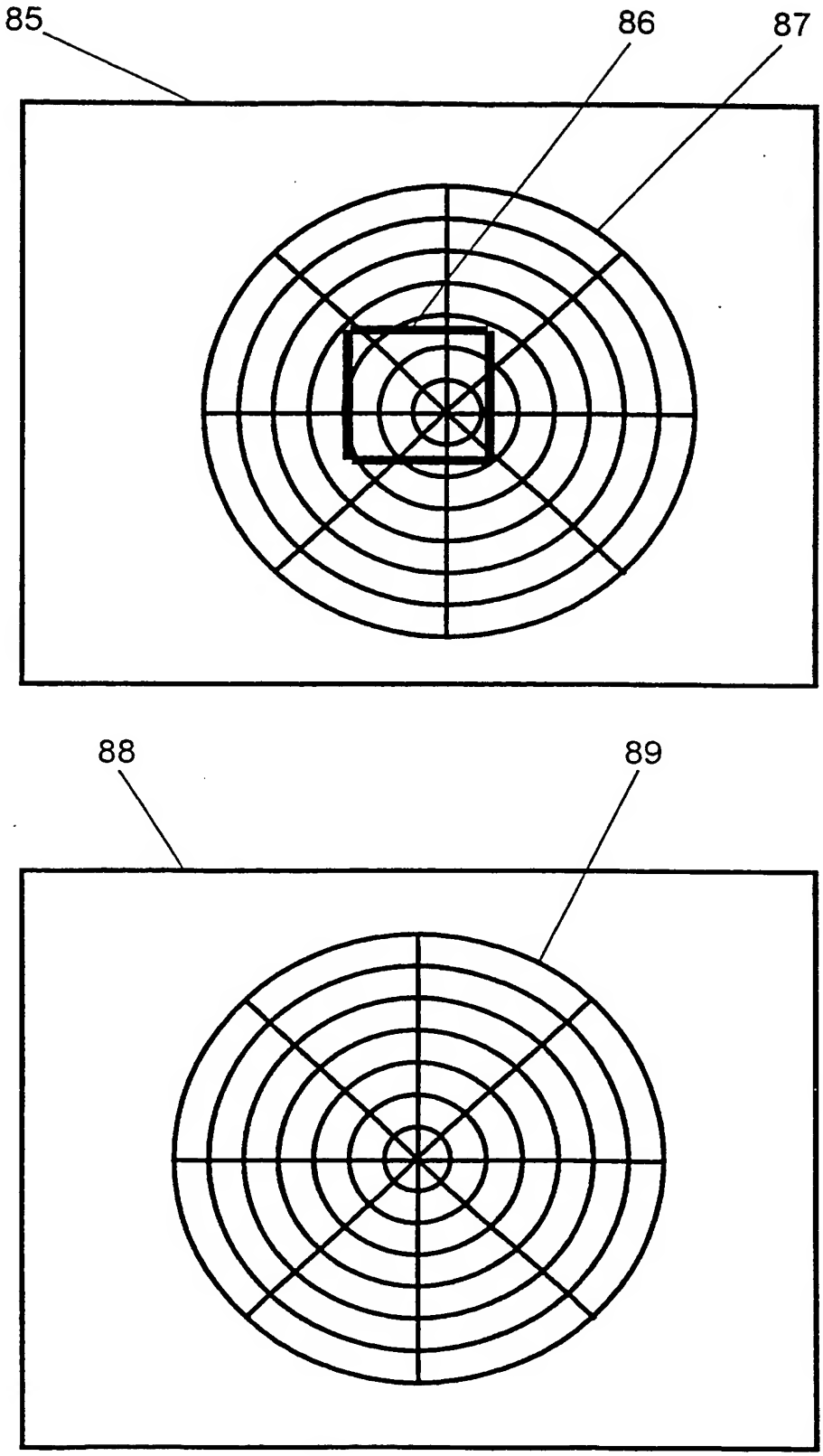

Figure 11

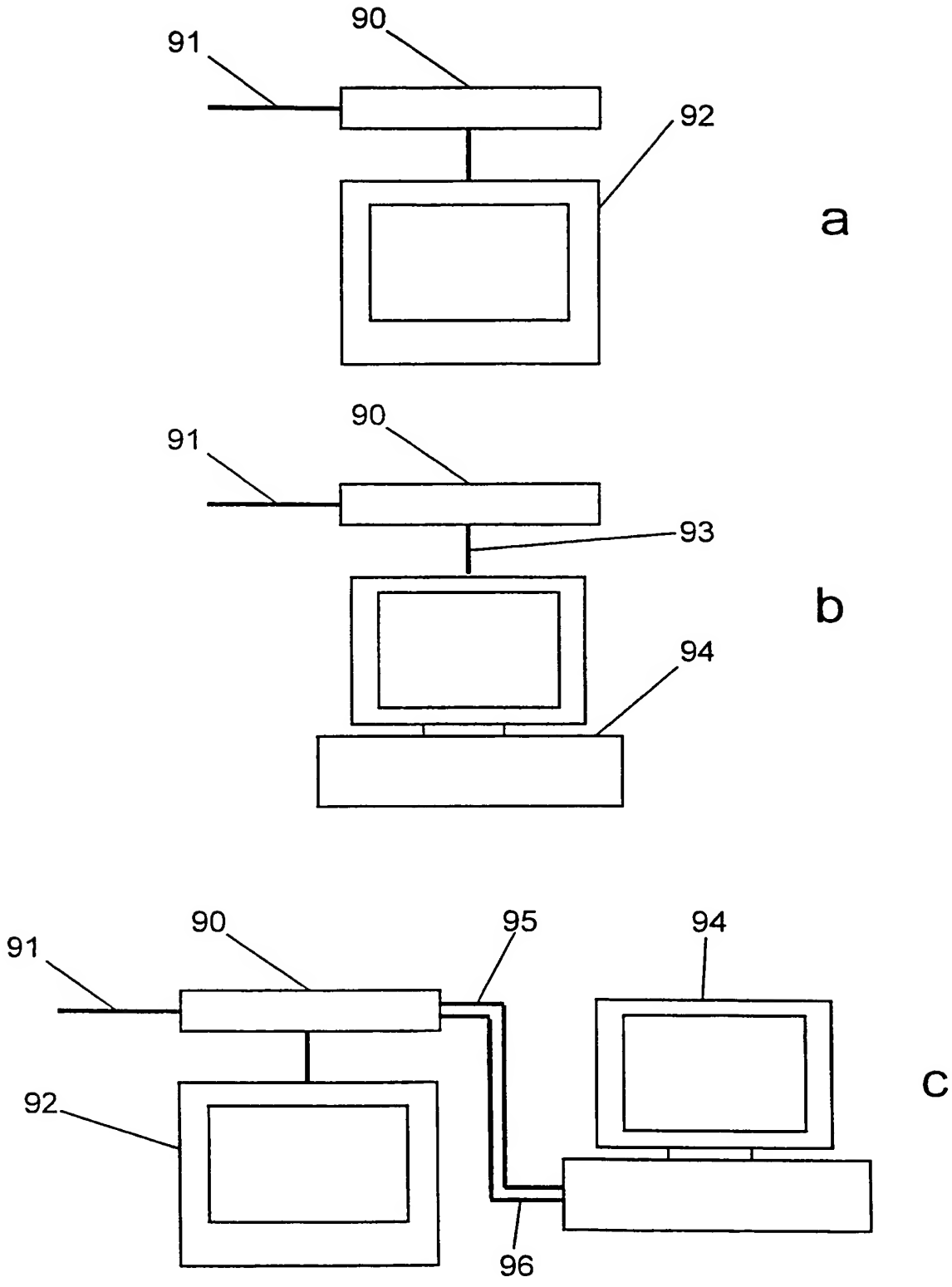

Figure 12

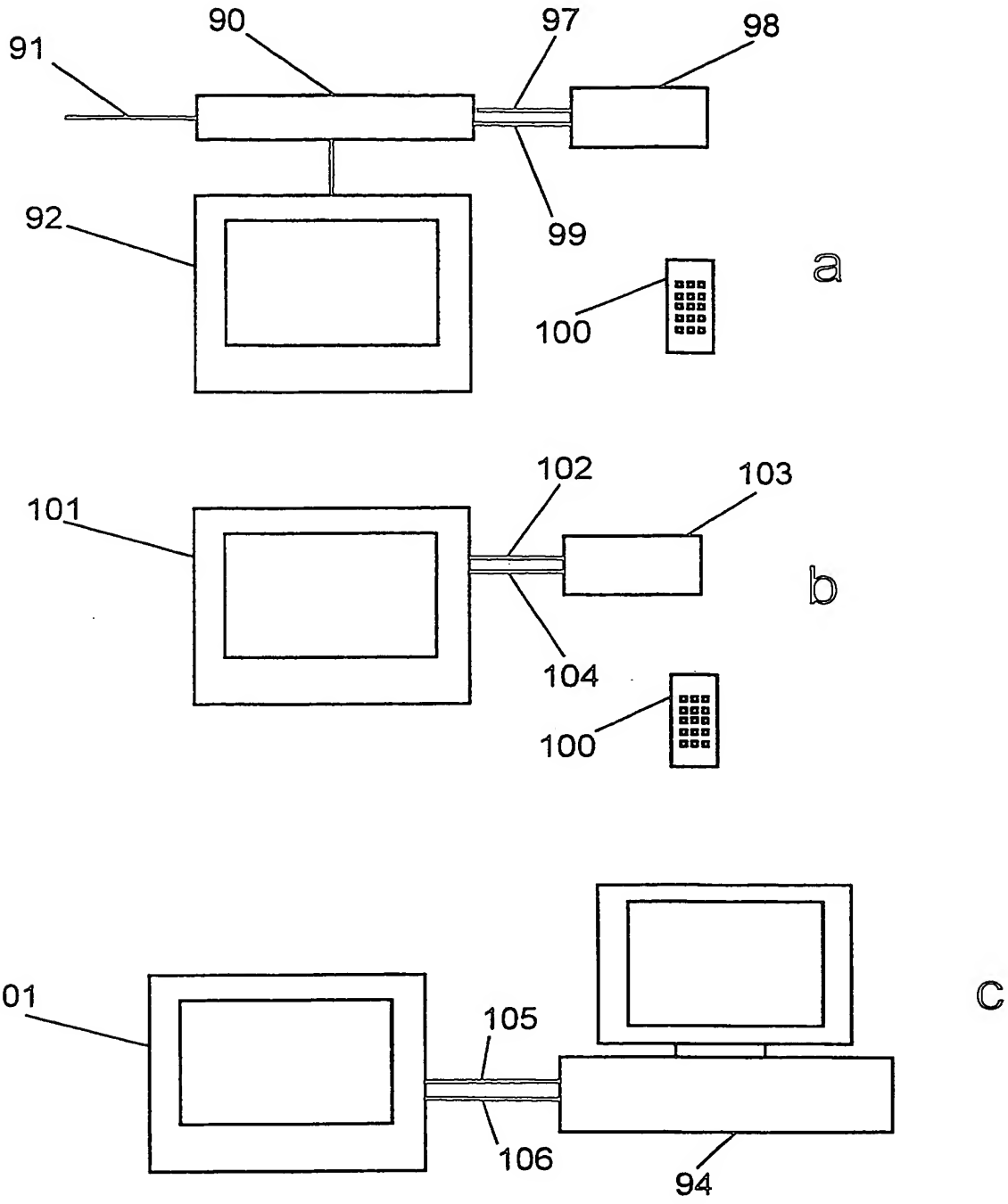

Figure 13

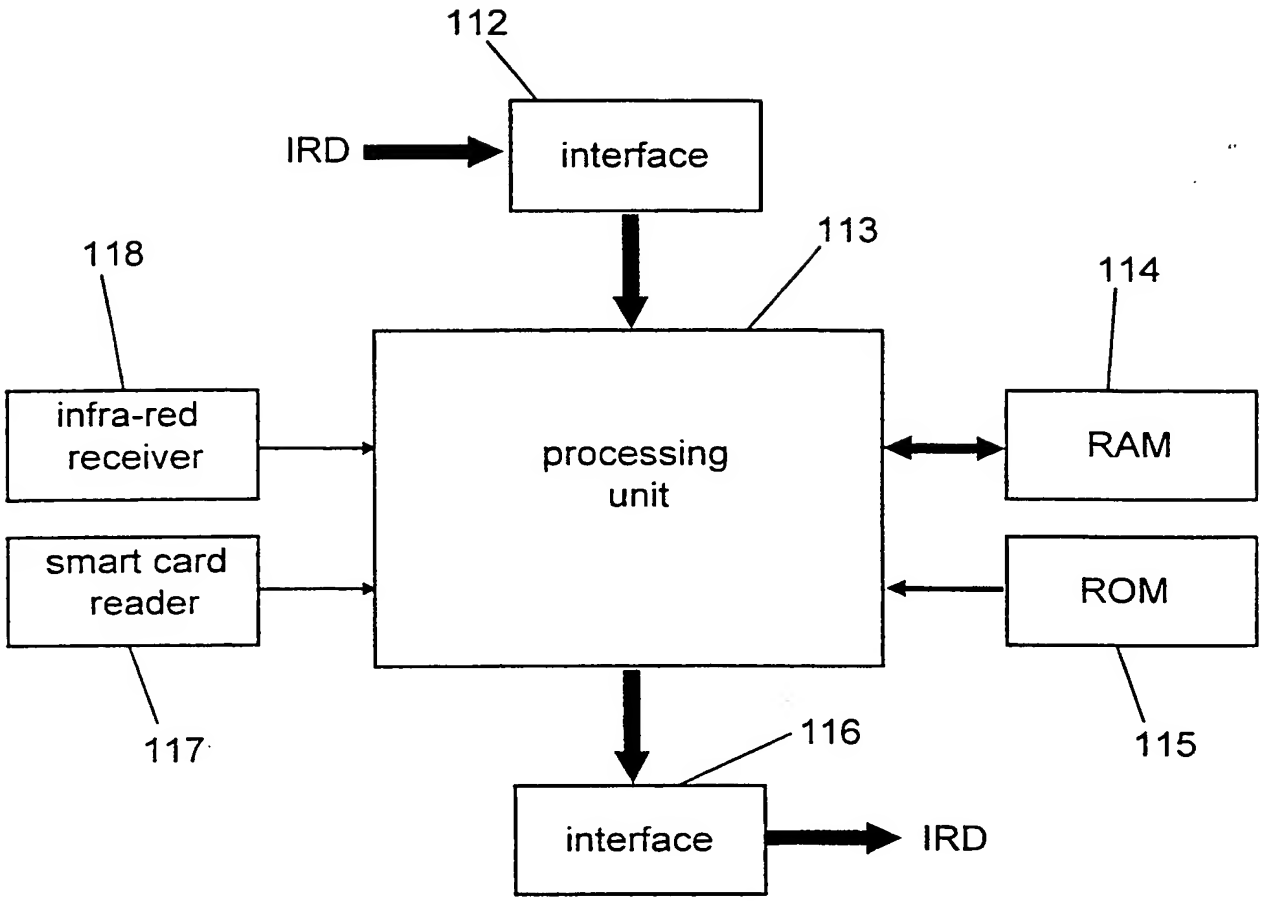
112
IRD
interface
113
118
114
infra-red receiver
processing unit
RAM
smart card reader
ROM
117
115
116
interface
IRD

Figure 14

PCT

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(74) Agent: LLOYD, Patrick, Alexander, Desmond; Reddie & Grose, 16 Theobalds Road, London WC1X 8PL (GB).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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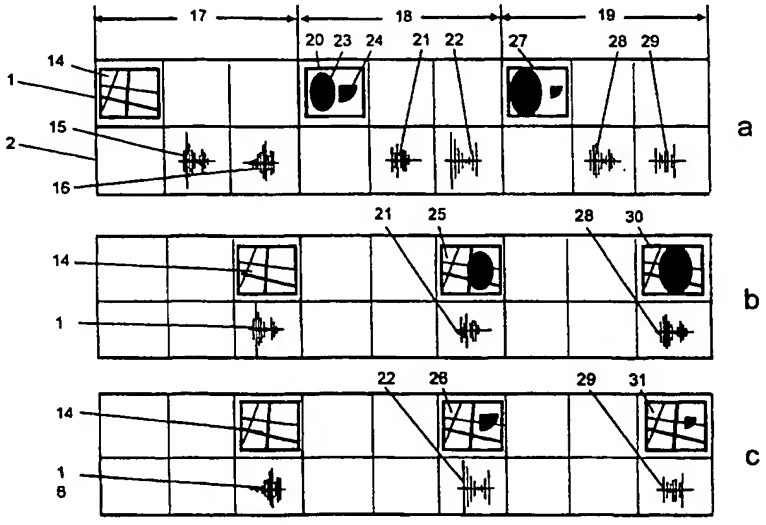
9 March 2000 (09.03.00)

(54) Title: INTERACTIVE TELEVISION AND RADIO SYSTEM



(57) Abstract

A system for the development and reception of locally interactive television and radio programmes. The system involves the creation of multiple programme sub–steams which can be selectively presented to the viewer in response to choices previously made by the viewer and logged by the viewers' receiving equipment. The interactivity is completely local so the data downloaded during the broadcast is all that is required to provide the viewer with all the alternative programme sub–streams. This system is suitable for all digital broadcasting systems. Background images (14) are distributed together with image groups (20, 27) which may be combined selectively with the background images to form separate programme sub–streams. The image groups may be distributed in the video stream or in the accompanying user/private data stream. The image groups may be selected for inclusion in one or more programme sub–streams.

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/02037

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
A	EP 0 827 340 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD) 4 March 1998 (1998-03-04) the whole document ---	1-5,7-9, 11, 14-18, 20-29, 31, 33-48, 51-53
A	US 5 422 674 A (HOOPER ET AL.) 6 June 1995 (1995-06-06) the whole document -----	1,6,7,9, 14-17, 20-25, 33-39, 43-48,51

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
22 November 1999	25. 01. 2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	VERLEYE, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 99/02037

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-53

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-53

Distribution of an interactive broadcast video programme, comprising distributing a video stream, having frames of at least one background image, and an associated control data stream, at least one of the control data stream or the video stream including streams of image sets, comprising at least one image portion, and the control data stream including instructions for combining one or more portions of the image sets with the background image to produce a plurality of possible video sub-streams

2. Claims: 54-56

Method for determining the origin of a video image using a previous related image having a known origin.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 99/02037

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 827340 A	04-03-1998	CN 1191449 A	26-08-1998
		JP 10126753 A	15-05-1998
US 5422674 A	06-06-1995	DE 69418580 D	24-06-1999
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		US 5493638 A	20-02-1996